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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/038,883	01/08/2002	Jianglei Ma	71493-1043 /pw	1163

7380 7590 11/03/2006

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EXAMINER	
JAGANNATHAN, MELANIE	

ART UNIT	PAPER NUMBER
2616	

DATE MAILED: 11/03/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/038,883	MA ET AL.	
	Examiner	Art Unit	
	Melanie Jagannathan	2616	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *31 January 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-32* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4,6-7,10-14, 17-18, 21-23, 27-32* is/are rejected.

7)☒ Claim(s) *5,8,9,15,16,19,20 and 24-26* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

- Examiner has considered Amendment after Non-Final mailed 1/31/2006. Examiner will withdraw previous office action in response to 1.131 Affidavit filed with amendment.
- Claims 1-32 are pending.

Claim Objections

1. Claims 11, 15, 17 and 18 are objected to because of the following informalities: Claims include "adapted to" language which suggests or makes optional but does not require the particular steps to be performed in the above claims. Subsequently, the claims raise a question as to the limiting effect of the language. Please see MPEP 2111.04. Appropriate correction is required.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1-4, 6, 21-23, 27-28, 31-32 are rejected under 35 U.S.C. 102(e) as being anticipated by Li US 6,654,429.

Regarding claim 1, the claimed method of inserting pilot symbols into OFDM frames at an OFDM transmitter having at least one transmitting antenna is disclosed by OFDM transmitter (Figure 1, element 100) including an antenna (element 108) and including a pilot symbol insertion block (element 110) which adds pilot symbols into the modulated signal. See column 3, lines 18-19 and lines 26-33. The claimed OFDM frames having a time domain and a frequency domain, each frame comprising a plurality of OFDM symbols is disclosed by OFDM sequence of blocks of symbols subject to inverse Fourier transform and fast Fourier transform at the transmitter and receiver.

Regarding claim 2, the claimed scattered pattern is a regular diagonal-shaped lattice is disclosed by pilot symbol grid (Figure 4a) where pilot symbols in one OFDM block do not occupy same tones as pilot symbols in nearby OFDM block providing a non-rectangular pilot symbol grid. See column 7, lines 11-27.

Regarding claim 3, the claimed wherein for each antenna, inserting pilot symbols in an identical diagonal-shaped lattice comprises for each point in the identical diagonal-shaped lattice inserting a number of pilot symbols on a single sub-carrier for N consecutive OFDM symbols, where N is the number of transmitting antennas is disclosed by at OFDM transmitter, pilot symbols are selectively inserted at predetermined tones in members of a sequence of OFDM blocks. Pilot symbol inserter (Figure 1, element 110) inserts pilot symbols into successive OFDM blocks to produce a predetermined pattern on a 2-D grid, each row comprising k tones of a corresponding

block, each column comprising the signal at a particular tone for each N OFDM blocks. See column 6, lines 16-26.

Regarding claim 4, the claimed wherein the diagonal shaped lattice is a diamond shaped lattice is disclosed by grid (Figure 4a), the diagonal placement of pilot symbols form a diamond shape.

Regarding claim 6, the claimed transmitting the pilot symbols with a power level greater than a power level of data symbols, depending upon a value reflective of channel conditions is disclosed by pilot-aided channel estimation where pilot symbols are broadcast using higher power than remaining symbols in data stream. See column 2, lines 16-19.

Regarding claim 7, the claimed transmitting the pilot symbols with a power level which is dynamically adjusted to ensure sufficiently accurate reception as a function of a modulation type applied to the sub-carriers carrying data

Regarding claim 21, 27 and 28, the claimed method of estimating a plurality of channel responses at an OFDM receiver having at least one receive antenna, at each receive antenna receiving OFDM frames transmitted by at least one transmitting antenna is disclosed by a receiver (Figure 2, element 120) provided with a plurality of antennas (elements 122a, 122b) receiving the signal from transmitter (Figure 1, element 100). See column 3, lines 41-49.

The claimed OFDM frames having a time domain and a frequency domain, the OFDM frames transmitted by each antenna having pilot symbols inserted in an identical scattered pattern in time-frequency, each OFDM frame comprising a plurality of OFDM

symbols is disclosed by OFDM transmitter (Figure 1, element 100) including an antenna (element 108) and including a pilot symbol insertion block (element 110) which adds pilot symbols into the modulated signal. See column 3, lines 18-19 and lines 26-33. The claimed for each transmit antenna, receive antenna combination using the pilot symbols of the received OFDM frames to estimate a channel response for each point in the scattered pattern is disclosed by the received signals with pilot symbols is sent to channel estimator (Figure 2, element 126). See column 3, lines 52-53 and column 4, lines 35-47.

The claimed estimating the channel response of a plurality of points not on the scattered pattern by performing a 2-D interpolation of channel responses determined for points in the scattered pattern, performing an interpolation in frequency direction to estimate the channel responses corresponding to remaining OFDM sub-carriers within each OFDM symbol is disclosed by channel parameters corresponding to positions other than pilot positions are obtained by interpolation using 1-D and 2-D IFFT, filtering and FFT. See column 1, lines 46-53 and column 5, lines 14-19.

Regarding claim 22, the claimed performing a filtering function on the channel responses prior to performing the interpolation in the frequency direction to estimate the channel responses corresponding to the remaining OFDM sub-carriers within each OFDM symbol is disclosed by signal is sent on for frequency domain filtering by diamond shape filter (Figure 2, element 152) before being sent on to 2-D FFT unit for channel estimation. See column 4, lines 67 and column 5, lines 1-19.

Regarding claims 23, 31-32, the claimed wherein the diagonal shaped lattice is a diamond shaped lattice is disclosed by grid (Figure 4a), the diagonal placement of pilot symbols form a diamond shape.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

5. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li.

Li discloses pilot-aided channel estimation where pilot symbols are broadcast using higher power than remaining symbols in data stream. See column 2, lines 16-19.

Li does not disclose the claimed transmitting the pilot symbols with a power level which is dynamically adjusted to ensure sufficiently accurate reception as a function of a modulation type applied to the sub-carriers carrying data. Examiner interprets the claimed dynamic power level adjustment of the pilot symbols to ensure accurate reception as a function of the type of data with the disclosure of Li changing the transmission power level of the pilot symbols relative to the data (from higher for the pilot symbols to a lower power level for the transmission of the remaining symbols). At the time the invention was made it would have been obvious to a person of ordinary skill in the art to adjust the power level. One of ordinary skill in the art would be motivated to do so for accurate channel estimation with less channel interference by focusing on the pilot symbols. See column 2, lines 16-19.

6. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Li in view of Baum et al. US 5,867,478.

Regarding claim 10, Li discloses a pilot symbol grid. However, Li does not disclose the claimed pilot pattern is cyclically offset, both in a time and frequency direction, for at least one adjacent base station to form re-use patterns. Baum et al. discloses a pilot code scheme and a cellular re-use pattern with three sectors per cell and a base unit located at the center of each cell. See column 5, lines 56-67 and column 6, lines 1-4. At the time the invention was made it would have been obvious to a person of ordinary skill in the art to modify Li with cellular re-use pattern of Baum et al. One of ordinary skill in the art would have been motivated to do this to minimize interference. See column 5, lines 24-31.

7. Claim 11-14, 17, 18 and 29-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Li in view of Ariyavisitakul et al. US 6,473,393.

Regarding claim 11, the claimed OFDM transmitter to insert pilot symbols into OFDM frames is disclosed by Li by OFDM transmitter (Figure 1, element 100) including an antenna (element 108) and including a pilot symbol insertion block (element 110) which adds pilot symbols into the modulated signal. See column 3, lines 18-19 and lines 26-33. The claimed OFDM frames having a time domain and a frequency domain, each frame comprising a plurality of OFDM symbols is disclosed by OFDM sequence of blocks of symbols subject to inverse Fourier transform and fast Fourier transform at the transmitter and receiver.

Li discloses all of the limitations of the claim except for a plurality of transmit antennas. Ariyavisitakul et al. discloses OFDM system with transmitter diversity where various transmitting antennas transmit OFDM signals and channel impulse response estimates are made between the signal received at receiving antenna and the various transmitting antennas. The estimates are made by computing a matrix. At the time the invention was made it would have been obvious to a person of ordinary skill in the art to modify Li's transmitter in OFDM system and pilot grid with the plurality of transmitting antennas and channel estimation of Ariyavisitakul et al. One of ordinary skill in the art would be motivated to do so for enhance transmitting operation by estimating channel parameters. See column 1, lines 61-64.

Regarding claim 12, the claimed scattered pattern is a regular diagonal-shaped lattice is disclosed Li by pilot symbol grid (Figure 4a) where pilot symbols in one OFDM block do not occupy same tones as pilot symbols in nearby OFDM block providing a non-rectangular pilot symbol grid. See column 7, lines 11-27.

Regarding claim 13, the claimed wherein for each antenna, inserting pilot symbols in an identical diagonal-shaped lattice comprises for each point in the identical diagonal-shaped lattice inserting a number of pilot symbols on a single sub-carrier for N consecutive OFDM symbols, where N is the number of transmitting antennas is disclosed by Li at OFDM transmitter, pilot symbols are selectively inserted at predetermined tones in members of a sequence of OFDM blocks. Pilot symbol inserter (Figure 1, element 110) inserts pilot symbols into successive OFDM blocks to produce a predetermined pattern on a 2-D grid, each row comprising k tones of a corresponding block, each column comprising the signal at a particular tone for each N OFDM blocks. See column 6, lines 16-26.

Regarding claim 14, the claimed wherein the diagonal shaped lattice is a diamond shaped lattice is disclosed by Li by pilot symbol grid (Figure 4a), the diagonal placement of pilot symbols form a diamond shape.

Regarding claim 17, the claimed transmitting the pilot symbols with a power level greater than a power level of data symbols, depending upon a value reflective of channel conditions is disclosed by Li by pilot-aided channel estimation where pilot symbols are broadcast using higher power than remaining symbols in data stream. See column 2, lines 16-19.

Regarding claim 18, Li discloses pilot-aided channel estimation where pilot symbols are broadcast using higher power than remaining symbols in data stream. See column 2, lines 16-19.

Li and Ariyavisitakul et al. do not disclose the claimed transmitting the pilot symbols with a power level which is dynamically adjusted to ensure sufficiently accurate reception as a function of a modulation type applied to the sub-carriers carrying data. Examiner interprets the claimed dynamic power level adjustment of the pilot symbols to ensure accurate reception as a function of the type of data with the disclosure of Li changing the transmission power level of the pilot symbols relative to the data (from higher for the pilot symbols to a lower power level for the transmission of the remaining symbols). At the time the invention was made it would have been obvious to a person of ordinary skill in the art to adjust the power level. One of ordinary skill in the art would be motivated to do so for accurate channel estimation with less channel interference by focusing on the pilot symbols. See column 2, lines 16-19.

Regarding claim 29, Li discloses all of the limitations of base claim 21 including the scattered pattern and pilot symbols used for channel estimation with pilot symbol grid (Figure 4a of Li). However, Li does not disclose N>=2 transmit antennas, each point in the scattered pattern containing a number of N consecutive encoded pilot symbols transmitted on a subcarrier, a single channel estimate begin determined for each N encoded pilot symbols. Ariyavisitakul et al. discloses OFDM system with transmitter diversity where various transmitting antennas transmit OFDM signals and channel impulse response estimates are made between the signal received at receiving

antenna and the various transmitting antennas. The estimates are made by computing a matrix. At the time the invention was made it would have been obvious to a person of ordinary skill in the art to modify Li's transmitter in OFDM system and pilot grid with the plurality of transmitting antennas and channel estimation of Ariyavisitakul et al. One of ordinary skill in the art would be motivated to do so for enhance transmitting operation by estimating channel parameters. See column 1, lines 61-64.

Regarding claim 30, Li discloses all of the limitations except for STBC block coding and STBC code rate. Ariyavisitakul et al. discloses space-time coding in OFDM system with transmitter diversity where data block is encoded by encoder (Figure 1, element 110). At the time the invention was made it would have been obvious to a person of ordinary skill in the art to modify Li with space-time block coding of Ariyavisitakul et al. One of ordinary skill in the art would be motivated to do so for high code efficiency and good performance. See column 1, lines 34-37.

Allowable Subject Matter

8. Claims 5, 8-9, 15-16, 19-20, 24-26 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Regarding claim 5, prior art of record does not disclose, in single or in combination, for each point in the diagonal shaped lattice, generating L uncoded pilot symbols, performing space time block coding on the group of L symbols to produce an

NxN STBC blocks, L and N determining the code rate in combination with the other limitations of the claims.

Claim 15 would be allowable for same reasons as indicated for claim 5 if rewritten to overcome claim objection noted above.

Regarding claims 8-9 and 19-20, prior art of record does not disclose, in single or in combination, the diagonal shaped lattice pattern comprises a first plurality of equally spaced subcarriers, a second plurality of equally spaced subcarriers offset from first plurality, wherein pilot symbols are inserted alternately in time using the first and second plurality of equally spaced positions in combination with other limitations of the claims.

Regarding claim 24, prior art of record does not disclose, in single or in combination, for each subcarrier averaging channel responses of the channel estimation period of a subcarrier before it is estimated in frequency and a subcarrier after the subcarrier is estimated in frequency and the channel response in previous and following estimation periods in combination with other limitations of the claim.

Regarding claim 25, prior art of record does not disclose, in single or in combination, filtering the channel responses with a 3-point smoothing operation in combination with other limitations of the claim.

Regarding claim 26, prior art of record does not disclose, in single or in combination, performing a linear interpolation for subcarriers at a lowest or highest frequency within the OFDM symbol and performing a cubic Lagrange interpolation for subcarriers at frequencies not equal to first or last frequency in combination with other limitations of the claims.

Response to Arguments

9. Applicant's arguments mailed 1/31/2006 have been fully considered and are persuasive. The previous rejection has been withdrawn and Examiner submits new grounds of rejection. Thus, arguments regarding prior art used in previous rejection are moot.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Melanie Jagannathan whose telephone number is 571-272-3163. The examiner can normally be reached on Monday-Friday from 8:00 a.m.-5:00 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Chi Pham can be reached on 571-272-3179. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Melanie Jagannathan
Patent Examiner
Art Unit 2616
October 30, 2006